FY 1996 - FY1999

The Bureau of Reclamation frequently lines and rehabilitates open channels, dams, and reservoirs with geosynthetics to conserve water and secure other benefits. Although the first Polyvinyl Chloride geomembranes were installed 35 years ago, new types of polymers, and new materials, as well as new construction techniques are continuing to develop. Monitoring the longterm performance of various geomembranes and conducting accelerated aging studies will assist design engineers and O&M personnel in answering the question, "How long will geomembranes last?"

The first part of this study was to retrieve existing geomembrane coupon samples from various canals, reservoirs, and dams and perform necessary testing to determine geomembrane durability. Results of coupon monitoring were to be published in technical papers and, at the end of the 3-year study, an update to the FY 1995 R-report, "Use of Geomembranes in Canals, Reservoirs, and Dam Rehabilitation" was to be published. New materials, such as polypropylene (PP), were to be monitored for durability. PP coupons were experiencing accelerated aging in the El Paso Solar Pond Project.
The second part of the study was to examine various geomembranes using laboratory testing techniques which investigate out-of-plane behavior. The American Society for Testing and Materials test procedures, "Large Scale Hydrostatic Puncture" and "Multi-axial Burst" were compared for several materials. The materials include: 30 and 40 mil PVC, 40 and 60 mil High Density Polyethylene (HDPE), two different 40 and 60 mil Linear Low Density Polyethylenes, 40 mil PP, and a 68 mil composite geotextile - Ethylene Propylene Diene Monomer product.
A summary report of both the field and laboratory portions of the project objectives was prepared and is currently being distributed.

Coupon samples obtained from South Dakota, Nebraska, Kansas, and Texas locations were analyzed and reported in the summary report, several technical papers, and an O&M Bulletin article. Field coupons were made of High Density Polyethylene (HDPE), Very Low Density Polyethylene (VLDPE), and Polypropylene (PP). All of these materials were designed and warrantied for placement in exposed environments, as well as covered applications, at the time they were installed. Many designers and water district personnel prefer exposed liners because they can increase the side slope angle and reduce required rights-of-way.

The exposed HDPE continues to perform well after 16 years of service. Minor holes are present in some locations due to animal puncture.

Exposed samples of VLDPE were analyzed after 3 years of exposure and were above the specified values. In the summer of 1998, however, a section of VLDPE (now 6 years into exposure) began to fail due to insufficient carbon black which is used to protect the liner from harmful UV rays. Just a few months after the Courtland Canal Section 1 was lined in 1992, the manufacturer withdrew its warranty for exposed VLDPE. Although this move did not affect our warranty, it did raise our suspicions of a possible premature failure. We continued to monitor coupons from this area and even cut out some problem areas within the primary liner. One section where problems occurred has been replaced under our warranty.

The exposed PP samples were located in a solar pond in El Paso, Texas, to accelerate PP high temperature

exposure conditions. An extensive coupon monitoring site was installed in this location 1 year following primary PP liner installation. Unfortunately, the primary PP liner failed after only 3 years of exposure because an improper stabilizer package was used in the PP and, therefore, the coupon monitoring was no longer of value.

The failures of both the exposed VLDPE and exposed PP are good examples of why we must continue monitoring these relatively new materials. It is much less expensive to fail a material in a test site than to have a material fail in a large project.

The second part of the study was modified to investigate the ability of the different geomembranes to conform to imperfect subgrades. Laboratory testing was conducted using Reclamation's hydrostatic test vessels and a new multi-axial burst device. This report is a product of the FY 1999 program.

Safety of Dams; Mike Kube, Supervisory Civil Engineer for Nebraska-Kansas Area Office; Boise Regional Office; Geosynthetics Research Institute; and various geomembrane suppliers.

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